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RESEARCH ARTICLE



Challenging practices: experiences from community and individual living lab approaches

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ABSTRACT

In this article, we examine a change initiative designed to involve households in testing ways to transform two everyday practices – heating and doing laundry. The research design included an examination of the challenges of changing practices either in a setting that fosters collective engagement or with individual households. Two different types of living labs were carried out simultaneously in eight European countries in Autumn–Winter 2018. We reflect on differences in results in terms of both changes in practices and the experiences of participating households that we argue can be at least partially attributed to householders' engagement in different types of living labs. We discuss the implications of an individual-focused vs. community-oriented approach for change initiatives seeking to challenge social norms for sustainability transitions, concentrating in particular on differences in the nature of participants' engagement and their willingness and ability to challenge routine practices. This is complemented by analytical reflections on the differences in design, interaction, and performance between the two types of living labs. We show that an explicit focus on collaborative engagement in living labs can produce results that reflect shared experiences, community support, challenging established norms, and collective commitment toward change.

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Community; energy transition; living lab; social learning; social norms; social practices

Introduction

A successful transition toward a sustainable energy system requires contributions from the household sector which is currently responsible for over a quarter of final energy consumption across the European Union (Alfredsson et al. 2018; Eurostat 2020). While infrastructure and other material conditions affect both existing consumption levels and the potential for reducing energy demand, consumption can also vary widely between households depending on each household's unique set of habitual activities. When viewing household-energy consumption as a consequence of the performance of everyday practices, differences in energy consumption can be attributed to variations in the energy intensity of practices as well as to the regularity with which they are performed. Understanding the

complex material and social reasons behind the performance of practices is a necessary step toward challenging the persistence of unsustainable practices.

As practices involve shared understandings of the performance of everyday life, community engagement could be one key in disrupting and reconfiguring unsustainable practices (e.g., Heiskanen et al. 2010). Living labs provide a temporally bounded space for experimentation that can also foster social interaction and mutual learning, for example in cases where assemblages of practitioners challenge existing norms to create new ways of living (Scott, Bakker, and Quist 2012). However, systematic research on the role and impact of intended and emerging opportunities for collective engagement and social interaction between living lab participants

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remains scarce. A recent systematic review of previous literature detects a lack of studies quantifying the value of living labs and comparative studies identifying the best performing approaches for living labs (Hossain, Leminen, and Westerlund 2019). This article seeks to address these knowledge gaps by comparing two different living lab approaches in terms of their quantitative and qualitative outcomes. We thus situate this research in the field of living lab studies as well as in the field of practice theoretical research, neither of which has previously addressed social interaction and learning in the context of home-energy use empirically in a comparative setting in living labs organized simultaneously in several countries.

The purpose of this exploratory research is to examine the differences in design, interaction, and performance between individual and community living labs, based on empirical data from the European Horizon 2020 ENERGIZE project. This three-year (2016–2019) research program set out to develop initiatives that challenge everyday practices, and within this framework to compare individual-engagement and community-oriented approaches. To this end, two different, yet comparable, types of living lab initiatives were designed, implemented, and evaluated. A total of 308 households took part in the living labs in eight European countries during Autumn–Winter 2018, either separately, with no direct contact with other participating households, or as a member of a living lab community involving participant interaction. Both living lab approaches set participants the same challenges regarding two everyday-household practices: to reduce space heating and laundry-washing cycles, thus ultimately lowering energy use. We examine whether the community and individual living labs delivered different results in terms of changes in practices and households' experiences of the engagement process. The comparison of the two approaches enables us to examine more closely what factors may be behind the observed differences and how the creation of a change-oriented community provides opportunities for mutual learning through participant interaction. We also discuss the implications for the design and implementation of future living labs that focus on reconfiguring social practices. This way, the research makes a contribution to the burgeoning body of literature on practice-based interventions and their methodologies (Laakso et al. 2021), including the role of different kinds of social interaction for practice change (Halkier 2020; Jack 2013; Sahakian and Wilhite 2014).

The next section discusses literature on practice approaches to understanding and changing household-energy consumption and on how community

engagement has been perceived as a promising approach for initiating change. It also presents our understanding of social learning in the context of these living labs. The third section describes the research design and implementation process, as well as the data and methods used in the analysis. The findings in the fourth section demonstrate how the living lab design and implementation affected participants' engagement and experiences. We highlight a small, but statistically significant, difference in the outcomes of the two different types of living labs, prompting an in-depth exploration of underlying mechanisms based on participants' self-observation and interview data. Our final section discusses the findings, the overall approach, and the limitations of the study, and concludes with a reflection on the relevance of this research for sustainability transitions more generally.

Changing practices at community level

To date, the majority of change initiatives in Europe that target household-energy consumption have typically focused on changing technology or individuals' behavior, for example by guiding consumers toward more sustainable alternatives or making consumption more efficient through technology (Jensen et al. 2019). However, the ability of such change initiatives to bring about real gains and lasting energy savings remains subject to intense debate (e.g., Rau et al. 2019; Watson et al. 2020), partly because they do not fundamentally modify the underlying practices or challenge routines. In fact, interventions can sometimes contribute to the locking in of unsustainable practices whenever wider social conventions are not addressed (Shove 2018; Spurling et al. 2013).

Many advocates of theories of practice treat practices as entities that are (re-)produced through their collective performance by large numbers of individuals or "carriers of practice" (e.g., Reckwitz 2002). In addition to their material elements (e.g., infrastructures, technologies, tools, and gadgets), practices always incorporate socially shared understandings of what is normal and appropriate, which in turn guide individuals' engagement in a practice (e.g., Dijk et al. 2019). Given the inherently social nature of practices that arises from these shared understandings, social groups can facilitate the collective reproduction of a practice or bundle of practices. This, in turn, raises interesting questions about the role of community (in all its variations ranging from intentional communities that involve cohabitation to inhabitants of housing estates and neighborhoods to large online communities with a very transient membership) in initiatives

that are intended to disrupt, reassemble, and transform routine practices.

An increasing number of change initiatives across Europe target households and their habits to lower household-energy consumption (e.g., Jensen et al. 2018).¹ The purpose of practice-based change initiatives is often to disrupt, reorganize, innovate, reorient, or otherwise modify routine practices (Strengers et al. 2015, 74). Change initiatives based on theories of practice thus seek to modify both the elementary composition of practices and the ways in which practices are performed, for example, in households or workplaces (Hargreaves 2011; Heisserer and Rau 2017; Hoolohan and Browne 2020; Welch 2016). Such approaches seek to accomplish social – rather than individual – change by finding ways in which conventional ways of doing, giving meaning to, and enabling practices are re-crafted via collective action (Spurling et al. 2013; Sahakian and Wilhite 2014; Vihalemm, Keller, and Kiisel 2015).

Given the focus of many practice-based initiatives on individuals and households (as opposed to workplaces or institutions), it makes sense to further explore the role of community in shaping household practices and related forms of (un)sustainable resource use. This is not to suggest that the individual can be entirely disregarded and omitted from a practice-focused analysis of change processes in society, as it is possible to observe significant inter-individual variations in how practices are performed (Backhaus, Wieser, and Kemp 2015). Similarly, people may associate various meanings with the same practice, appreciate different skills, or implement the practice with distinct material elements. In fact, space heating and doing laundry are well-established domestic practices that show significant variations in performance (Sahakian, Rau, and Wallenborn 2020 for home heating; Mylan and Southerton 2018 for laundry). Deliberate experimentation either by individuals or within a specific community setting can likewise change practices and contribute to the spread of new ways of thinking and doing across a community that shares that particular practice (Shove and Walker 2010; Rabadjeva and Butzin 2020).

Over the past two decades, “community” (i.e., a group of individuals that share a place, worldview, and/or particular interest and can involve face-to-face exchanges and/or virtual communication between group members) has been heralded in policy and academic debates as a potentially useful concept for addressing pressing environmental and climate-change challenges (Goggins, Fahy, and Jensen 2019; Hauxwell-Baldwin 2013). Social influence has been studied, for example, in the context of resource use (e.g., Abrahamse and Steg 2013;

Dupré and Meineri 2016). Communities play a significant role in promoting social cohesion, shaping our lived experiences, and the ways in which we conduct ourselves, including our energy-use practices. Walker (2011, 777) has highlighted the prevailing view of community as: “positive, productive and contributing to the successful implementation and social embedding of various forms of carbon-reduction activity.” At the same time, community can also be a key source of social control, fostering uncritical “group think” and disciplining members who transgress established norms. For example, research has shown that the ways in which people act can be influenced considerably if a change in norms (Opp 2001) is initiated from within their own social group (Burchell, Rettie, and Roberts 2016; Helliwell 2014).

There are, as a result, tremendous expectations around what a “community” might achieve. Communities are expected to offer solutions to problems encountered in previous attempts to change individual behavior – problems including socio-technical infrastructures, social conventions, social dilemmas, and the helplessness of individuals (Heiskanen et al. 2010). According to Walker (2011), engaging with communities is expected to lead to better outcomes in terms of individual behavior change and the creation of social innovations facilitating the deployment of sustainable energy technologies. Nevertheless, there is also research that warns against assuming community as “an unproblematic entity through which people can come together to deal with environmental problems” (Aiken et al. 2017, 2). Some studies have highlighted situations where community has been used instrumentally as a delivery mechanism, while continuing to rely on an individualist problem framing, a focus on changing behavior, and an emphasis on small-scale technological fixes to improve energy efficiency (Burchell, Rettie, and Roberts 2016; Hauxwell-Baldwin 2013). However, despite their criticism, Aiken et al. (2017) acknowledge that “community” remains attractive as a site of research investigation, since to the members there is still something enabling in belonging to a community.

Mindful of the lack of empirical studies on this topic, this article explores the process of changing practices in a community setting as well as by engaging with individual households one-by-one. Acknowledging communities as sites of contestation, difference, tension, and distinction via social interaction, we are interested in how learning can be a form of initiation into new practices in a community created as part of the living lab design. We refer to the literature on social learning in a group of people whose members either deliberately or

unintentionally participate in the same practices (e.g., Lave and Wenger 1991; Reed et al. 2010; Sahakian and Wilhite 2014).

We recognize the difficulties of attributing social learning to a community setting and of distinguishing between individual and social learning in context. We acknowledge that individuals also learn from each other, networks, and communities to which they belong. Individual learning can be defined as individuals gaining explicit and abstract knowledge in the form of ideas, facts, and concepts (Reed et al. 2010). Contrastingly, we understand social learning as conceptualized by Reed et al. (2010, 1) who state that

[T]o be considered social learning, a process must: (1) demonstrate that a change in understanding has taken place in the individuals involved; (2) demonstrate that this change goes beyond the individual and becomes situated within wider social units or communities of practice; and (3) occur through social interactions and processes between actors within a social network.

In combination, these three factors distinguish social learning from individual learning. In our research design, we expected the community setting to enable peer support in which participating households learn from each other by discussing and comparing their experiences. Since there is significant individual variation in how practices are actually performed in households (Hui 2016), participants can recognize opportunities for change and learn how alternative ways of performing practices are actually done, as well as develop a common pool of knowledge and skills (Laakso, Heiskanen, and Matschoss 2017).

Living lab design, interaction, and performance evaluation

This section explores the design, interaction, and performance of the process of changing practices in a community setting and by engaging with individual households one-by-one in an energy-related practice-based change initiative. The study is based on an exploratory, experimental approach addressing several elements of practices in an attempt to support the re-crafting of everyday habits and routines in the home (Sahakian et al. 2021 for overall results).

Designing living labs to experiment with practice change

Implementing similar change initiatives across households while simultaneously exploring possible effects arising from participants' collective engagement required a defined focus, clear timeline,

generic process of engagement, coherent strategies for participant selection, and use of suitable tools for data collection. The decision to focus on two mundane practices – heating and doing laundry – was informed by a range of considerations, including input from members of the advisory board of the project. Since home heating consumes the biggest share of energy used by private households in Europe (Eurostat 2020), the focus on the former follows from the pressing need to move beyond energy efficiency and toward sufficiency by reducing overall energy consumption. The interest in laundry practices emerged because of its high visibility, its entanglement with other domestic practices, including space heating to accelerate indoor drying and dressing for work, and the particular significance of gender- and age-related roles in its performance. Crucially, both practices have a strong bearing on socially mediated and shared perceptions of comfort and convenience (Laakso and Heiskanen 2017; Sahakian et al. 2021). In addition, these practices were selected for practical reasons, including their prevalence in all participating countries.

As a research design, we used a living laboratory approach. Living laboratories, or living labs, have proliferated as a particular form of real-life experimentation, for example in urban areas (Bulkeley et al. 2016), universities and workplaces (Evans et al. 2015), and homes (Devaney and Davies 2017). The European Network of Living Labs² defines them as “user-centred open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings” (Hossain, Leminen, and Westerlund 2019). In this research, living labs are understood as spatially and temporally bounded experiments in a real-life setting that facilitate different forms of learning. Participants, such as individuals and households, are seen as co-creators of knowledge on equal grounds with researchers.

Importantly, living labs are not just focused on product or service development but also on how various technologies and practices interact in the context of everyday life. Like other forms of social experimentation, they are initiated not only by researchers and universities, but also by communities, firms, and grassroots organizations. What separates practice-based living labs from other types of living labs is their explicit focus on practices, their dynamics, and underlying, socially structured norms and conventions, competencies, and materialities (Devaney and Davies 2017; Laakso, Heiskanen, and Matschoss 2017). In this research, living labs were designed to provide space for bottom-up experimentation with new practices, to facilitate systematic

monitoring of the process of challenging practices and learning within a project, and to enable the use of the knowledge created among the participants (e.g., Schliwa et al. 2015).

We chose a challenge as an engagement method. This choice is based on our analysis of more than 1,000 initiatives for sustainable energy use in Europe (Jensen 2017; Jensen et al. 2019), which provides a summary of different methods that may work in different contexts (Heiskanen et al. 2018). For laundry, households challenged themselves to reduce their washing cycles, either by half, which was the target suggested by the researchers, or by setting their own goal, if the suggested challenge was not considered feasible. For heating, households challenged themselves to lower the indoor temperature, either to 18°C (64°F) according to the target set by the researchers, or to their own temperature-reduction target. More important than achieving the set goals was that the participants reflected on the process of change, and how (or if) their practices changed, and why (not). The focus on experimentation and learning was highlighted from the beginning, to underline the importance of changing the everyday routines in novel ways rather than meeting the target.

To explore the effects of collective engagement and shared learning experiences in instigating change in social practices, two types of change initiatives in the form of living labs were carried out. One type of living lab approached and engaged households individually (ILL – individual living lab), while the other engaged with a group of households as part of a “change community” (CLL – community living lab) (see Figure 1 and the section about implementation for more details about the community involvement). Groups of households participating in the CLL varied in their composition (e.g., participants recruited from existing communities in multi-apartment dwellings, particular villages, or neighborhoods); however, they all received the same type of instructions, toolkits, and opportunities for interaction among the participating households. In the second half of 2018, the two types of living labs were implemented across eight European countries: Denmark, Finland, Germany, Hungary, Ireland, Switzerland, the Netherlands, and the United Kingdom. The timeline foresaw an intense period of seven weeks of experimentation (the “active” phase), preceded by a four-week baseline period that captured typical practices.

The research design was built on the methodologies of Scott, Bakker, and Quist (2012) and Kuijer and de Jong (2012) on deconstructing the practice, experimenting with alternative practices, and deliberating on the experiences (see Laakso, Heiskanen, and Matschoss 2017). Crucially, the research design

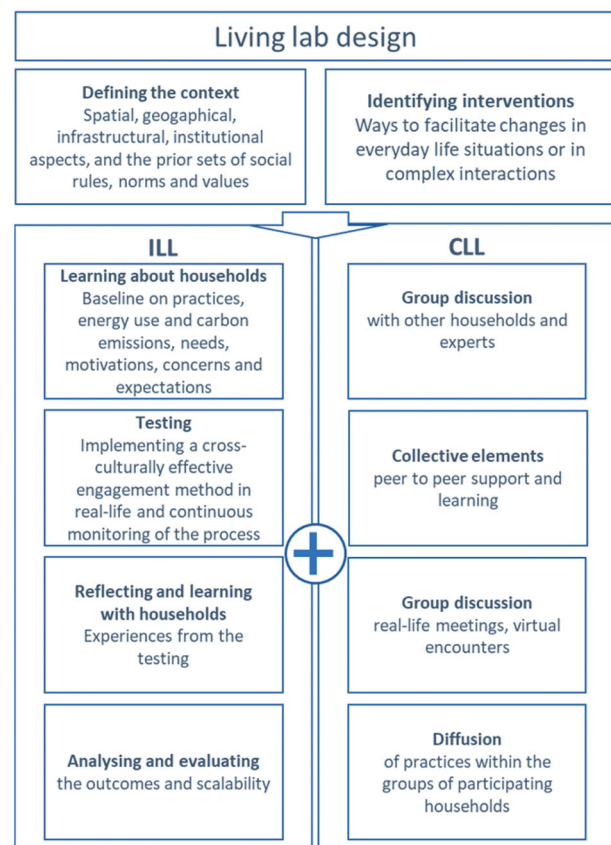


Figure 1. Design of two types of living labs.

allowed for comparisons of qualitative differences between ILL and CLL participants regarding their engagement in and experience of experimenting with alternative heating and laundry practices. Moreover, the research design combined individual data-collection methods allowing for triangulation (ILL and CLL: electricity meters, temperature loggers, surveys, diaries) with research methods that facilitated critical engagement and social learning in a group setting (CLL: focus groups and online discussion). For comparability of the results, both ILLs and CLLs were implemented in as similar a way as possible in all countries (see Laakso, Matschoss, and Heiskanen 2019).

Large amounts of both quantitative and qualitative data were collected during the baseline period and the active phase, with households completing weekly (electronic) questionnaires and diaries. The format of the diary made it possible to record both actual energy savings and changes in practices. In addition, a thermometer that measured and recorded the indoor temperature was used throughout the change initiative to collect quantitative data, to complement qualitative information provided by the householders themselves. The thermometers, electricity meters, and diaries also supported the self-monitoring of the process, which was valuable for the interviews and focus-group discussions at the start and end of the active phase (see Hitchings 2012).

Table 1. Surveys and tools used for data collection and the number of respondents^a.

Survey	Type of data collected	<i>n</i>	Time of data collection
Recruitment questionnaire	Basic household information including number of members, age, education, and occupation	266	June to October 2018
Start questionnaire	Household routines and ways of heating and doing laundry	261	August to November 2018
Final questionnaire	Changes during challenge and experiences of households	241	November to February 2018
Diaries	Changes in practices and energy savings	239	September to November 2018
Weekly survey	Changes in practices and energy savings, emotions of participants	260	September to November 2018

^aAll surveys and tools can be found at http://www.energise-project.eu/livinglab_materials.

Table 2. Interview data collected October–December 2018^a.

Country	Country code	Deliberation interview (number of households)	Exit interview (number of households)	Deliberation focus group (number of participants)	Exit focus group (number of participants)
Finland	FI	19	19	15	14
Germany	GER	20	20	13	11
Hungary	HU	20	20	20	20
Ireland	IR	20	17	12	10
Netherlands	NL	20	20	12	12
Switzerland	CH	20	20	12	11
United Kingdom	UK	20	20	13	7

^aDenmark is not included in the analysis of interview data as the Danish researchers responsible for the organization of the living labs are not among the authors of this article.

Multiple questionnaires were administered in all participating countries at different stages including during the recruitment phase, at the start of the living lab, during the living lab (weekly questionnaires), at the end of the challenge (final questionnaire), and three months after its completion (Table 1). Our quantitative analysis used data from the first three questionnaires collected in the seven partner countries.³

In addition to surveys, households were interviewed at the beginning and end of the challenge period (Table 2). Focus-group interviews were held with the CLL in each country at the beginning of the challenge (deliberation interview) and at the end (exit interview). In the ILLs, the households were interviewed individually during home visits. Interview data were collected and analyzed by means of systematic notes, in which the answers to the same questions were recorded for each interviewed household. Focus-group interviews asked the same questions as individual interviews, but also included questions that sought to clarify the importance of community elements in the challenges, such as challenging social norms and enhancing social learning. The interviews were recorded and report templates were filled in and used for cross-analysis.

Implementation and interaction in community and individual living labs

The project partners used several strategies to recruit participants for both living labs. These approaches included recruitment advertisements in

newspapers, on websites, and in local stores, or with the assistance of local implementation partners (e.g., a local energy agency). We targeted participants with no/limited prior experience with energy-related change initiatives. However, our analysis of the recruited households showed that at least some of them had a heightened interest in energy issues.

When considering how to set up the CLLs, we consulted prior research on community-based interventions in different types of communities (Heiskanen et al. 2010; Middlemiss 2011). For practical reasons, we recruited participants for the CLLs from already existing local communities of interest and places where this was feasible. This was done to ensure that participants could attend the focus-group meetings without much practical difficulty (e.g., long trips) or spontaneously encounter each other (e.g., in the supermarket). This meant tapping into already existing local links between households prior to their participation in the CLL. For example, some CLL participants knew each other personally prior to their agreeing to join in the project, although many became acquainted through their engagement. While it is not possible to disaggregate prior contacts from personal connections forged during the CLL, we are confident that participation in the living lab provided more direct opportunities for interactions between householders around the issue of energy use (a topic that is usually not central to people's everyday conversations in their local community). Moreover, having something in common, be it a place of residence or an interest, was

believed to help establish mutual trust and a sense of communality within the CLL.

The selection criteria for the participating households included the opportunity to do laundry in their building or home, and the ability to influence the indoor temperatures. Efforts were also made to include a broad range of households ([Appendix A](#) illustrates participants' background information in different living labs in more detail).

The challenge periods commenced and concluded with focus-group meetings in the CLLs, with a view to forging links between participants and to encourage discussion. In the first meeting, the challenges were discussed jointly, yet households defined their individual targets that fit their personal circumstances. During the concluding focus-group meeting, CLL participants collectively evaluated the process, discussed lessons learned, and reflected upon their experiences. Throughout the entire challenge period, CLL-households had the opportunity to engage in online conversations to share tips, experiences, and ideas with the group. The ILL-participants, in contrast, had planned communication about the project only with the research team but not with each other. However, the research team did not request them to refrain from talking about the challenge with other people, and they did have interactions with others not participating in the living labs.

Methodology for measuring performance

Initially, we ran a series of *t*-tests of independent samples to identify any statistically significant differences in outcome between ILLs and CLLs. This assessment was complemented with an in-depth analysis of the qualitative interviews to find possible reasons for these differences. Arguably, combining survey and interview data provided a much deeper understanding of the impact of our living lab design (ILL or CLL) on efforts to change household practices. While the survey data revealed the magnitude of effects, the interview data shed light on how the households experienced the challenge of practice change in the living lab engagement. Such understanding can help to guide future change initiatives toward more effective designs.

First, we considered differences between CLLs and ILLs regarding reductions in room temperature and laundry cycles during the challenge period ([Appendix B](#)). Next, we linked qualitative information about the collaborative learning experiences of participants with survey data about shifts in practices. Respondents were asked to rate their engagement in novel ways of heating and doing laundry since the start of the challenge using a five-point Likert scale (1 = much less frequently, 5 = much

more frequently). We formed sum variables based on the items from the survey and measured participants' engagement in novel ways of heating and doing laundry. For an in-depth understanding of the changes, we analyzed data collected during individual interviews and focus groups. [Table 2](#) lists the interview data that we collected.

In analyzing the interview (ILL) and focus group (CLL) data, we utilized a systematic note-taking template. The themes in the interviews were related to, among other things, the ways of washing and heating and the material and social elements associated with them, as well as the changes that occurred during the challenges. Particular attention was paid to how participants evaluated their participation in a CLL or ILL. More specifically, we analyzed what the main differences were between CLLs and ILLs regarding participants' experiences of them. We also tried to understand whether and to what extent social norms and other meanings were challenged in focus groups (CLL) and individual interviews (ILL), respectively. In particular, inspired by previous research and our quantitative data, we explored discussions concerning individual variations in the performance of practices, and the sharing of alternative ways of performing practices. We also explored whether CLL participants influenced each other's practices and, if so, how this took place.

Results

This section presents the main results of our comparative analysis of the two types of living labs. Following a summary of participants' responses to the challenges in the different kinds of living labs, we report on the main differences in practice change between CLLs and ILLs and then the differences in engagement between the two types of living lab, including reported differences in participants' exposure to social norms.

Performance: participants' responses to ways of challenging practices

Overall, the differences in outcomes between the ILLs and the CLLs in terms of average reductions in indoor temperatures and laundry cycles were small. However, we did find some statistically significant differences in terms of reductions in bedroom temperatures (see [Appendix B](#)) and, in particular, in the adoption of alternative elements of heating and laundry practices having to do with adopting new skills and utilizing material elements. We analyzed the differences in how households responded to claims regarding different practices related to heating and laundry (five-step Likert scale with

Table 3. Means and standard deviations (SD) of the adoption of alternative elements of heating practices.

Heating	CLL		ILL	
	Mean	SD	Mean	SD
Wore extra clothing to keep warm	4.08	0.758	3.95	0.708
Wore socks or slippers to keep warm	4.04	0.801	3.80	0.784
Used a blanket to keep warm during the day, for example, when sitting on the sofa	3.90	0.801	3.76	0.696
Used an extra blanket to keep warm during the night	3.46	0.708	3.31	0.696
Had warm foods or drinks to keep warm	3.46	0.627	3.33	0.590
Moved around more in order to keep warm	3.25	0.491	3.17	0.471
Spent more time with family/friends in the same room	3.20	0.569	3.15	0.487

Table 4. Means and standard deviations (SD) of the adoption of alternative elements of laundry practices.

Laundry	CLL		ILL	
	Mean	SD	Mean	SD
Examined clothes carefully to see if they needed washing	4.07	0.741	3.97	0.819
Stored slightly used clothes in order to reuse them before washing	4.05	0.705	3.89	0.711
Aired clothes to postpone washing them	3.94	0.717	3.73	0.748
Removed stains without washing the entire item	3.73	0.771	3.63	0.772
Washed at colder temperatures	3.73	0.876	3.70	0.817
Washed fuller loads	3.84	0.830	3.66	0.806

Table 5. Summary of sum variable comparison between CLLs and ILLs.

Variable	Descriptive statistics	CLL	ILL	<i>t</i>	<i>p</i>
Sum variable means for alternative ways of keeping warm	Mean	3.63	3.50	−2.177	.030
	SD	0.488	0.442		
	<i>n</i>	113	128		
Sum variable means for alternative ways of taking care of the laundry	Mean	3.90	3.77	−2.206	.028
	SD	0.450	0.455		
	<i>n</i>	113	126		

1 = significantly less than before and 5 = significantly more than before). Statements, mean answers, and standard deviations are presented in Table 3 (heating) and Table 4 (laundry).

The results show that the means for adopting alternative ways of keeping warm and taking care of laundry were higher in CLLs in all alternatives presented than in ILLs. This means that, on average, the households in CLLs reported having changed their ways of keeping warm and taking care of laundry more than reported by participants of the ILLs. In addition, the standard deviations in all *heating*-related practices were higher in CLLs than in ILLs, suggesting a broader range of scores in reported adoption of novel ways of keeping warm. In *laundry*, however, the changes are not as clear. In order to analyze whether the observed difference in practice change between the living labs is statistically significant, we formed sum variables of the alternatives presented in Tables 4 and 5.

We assessed the reliability of the sum variables using Cronbach's alpha coefficient. There were seven statements ($\alpha = 0.828$) in the sum variable for heating and six statements ($\alpha = 0.614$) in the sum variable for laundry. If the value of the alpha coefficient is greater than 0.6, the sum variables can be considered a sufficiently reliable variable (Metsämuuronen 2002). The sum variables constructed using the alpha test are internally consistent

although some items in alternative ways of keeping warm or taking care of laundry are at slightly different levels from the practice perspective (e.g., all being in the same room compared to wearing woolen socks). The mean of the sum variable for the CLLs deviated significantly from the mean of the ILLs sum variable in both cases (heating and laundry) (Table 5).

These results show that the households that were part of the CLLs reported higher levels of engagement in alternative elements of heating and laundry practices than households in the ILLs. These results prompted further investigation to identify possible explanations for these differences.

Design: differences in experienced change

There were some differences in how the participants experienced taking part in the challenge depending on the type of living lab in which they were engaged. Some participants of the ILLs in several countries stated that they would have preferred participation in the CLL and some participants in the CLLs felt that without the group they would not have been able to commit to the challenge, as illustrated by a quote from a CLL participant with others agreeing by nodding: "The fact that we committed to these challenges as a group motivated me to really engage with the challenge" (CLL, NL

Participant 1), or keep up that commitment until the end of the challenge. In addition, being a member of a CLL seems to have encouraged some participants to actively support the challenge and keep it up even after the challenge period. Participants in CLLs underlined that it was important for people to see and hear that there are others who do similar things, and that they are not alone in their endeavor to change unsustainable practices: “There was just a sense of being committed to this because you first discussed it together with others, and that way you got a feeling, like you might not have had the same feeling about it if you had just ... started to fill the diaries” (CLL, FI Participant 11).

Another influential factor was the availability of peer support in the CLLs. Participants in the ILLs pointed out that it would have been interesting to have an opportunity to exchange experiences with other households. In some cases, ILL participants asked the researchers how the other households were doing. As one ILL participant stated, “[H]ad there been a social side of it, that there would have been some forum... where you could have gotten peer support, that you could have discussed, like: ‘This is horrible, I washed five laundry cycles this week,’ how are others doing, and you could have gotten tips” (ILL, FI Participant 37). The CLL participants observed that discussing their practices with others in a group conversation helped them reflect on their own laundry and heating practices. For example, some participants reported that the events organized in the CLL offered them a possibility to reflect upon their changes in practices, given that their household members were not so keen in engaging with the challenge, which led them also to vent on how difficult it is to challenge prevailing unsustainable social norms and convince others to join in.

Being committed to the challenge in a community setting could also relate to social pressure, as one participant stated: “Yes, there is a bit of social pressure, I think that if I had been the only one in the building doing it then I would have given up, I would have decided I didn’t care, I knew that today was the final reckoning” (CLL, CH Participant 13). This indicates that being part of a CLL may have been a greater rupture than simply being involved in a project without contact to other participants. The opportunity to gain insight into other participants’ experiences and to challenge their existing practices was frequently mentioned in positive ways by participants from different partner countries. Some participants mentioned that seeing that others did things differently helped them recognize that they were not acting as ecologically as they had thought, which was considered a positive realization

and an opportunity for learning. By contrast, participants also noted that relating their own practice to a responsive group gave them a kind of confirmation that they were on a “good path.” For example, one participant noted, “The fact that we committed as a group stimulated me to live more sustainably and consciously” (CLL, NL Participant 2). The group discussions thus broadened participants’ understanding of the number of ways practices could be performed and that one’s own way of performing a practice was not the only or the correct way.

Differences in emotions were observed in some countries while overall differences were not statistically observable. For example in Hungary, there were more worried participants in the ILL during the laundry challenge than in the CLL according to weekly surveys. During the heating challenge, the number of positive expressions were lower in the ILLs (Vadovics and Pap-Szuromi 2019). However, there are large differences between participants in how they experienced the challenge showing that changing practices is not an easy activity and that it is likely to involve also anxiety and stress.

Interaction: differences in engagement in the living labs for challenging social norms

In this subsection, we discuss differences in engagement in the two types of living labs and in relation to challenging social norms. We understand “challenging social norms” as a reflection on or an exposure to variation within commonly held norms and discussions of deviance from previous practices. We observed that the group context in the CLLs served to make norms surrounding cleanliness visible by creating a space where such norms could be considered. Importantly, the group context also highlighted different ways of performing practices that participants had assumed were common across households.

CLLs served to highlight the invisibility of norms surrounding laundry and cleanliness. Participants said that it is not generally easy to talk about laundry with others outside of their group. Some participants stated that they were not keen to discuss issues around cleanliness or thermal comfort especially with work colleagues, even though some of these participants acknowledged that they were influenced by social norms in the workplace. Participants who acknowledged mentioning the challenges at work or when talking to neighbors, friends, or relatives reported that the discussions were mainly about the heating challenge and about the suitable indoor temperatures. Only some of the participants mentioned having discussed laundry,

and the conversations in these cases mainly focused on the number of wash cycles and thus highlighting that cleanliness is not an easy topic to discuss. This emphasizes the role of the community created around the challenge in deliberating upon these norms as it provided a setting that participants considered to be sufficiently secure and protected to enable open conversations.

In some cases, the group supported the participants when they challenged shared understandings of cleanliness. For example, some people stated that they were relieved to hear that it may not be necessary after all to wash the bed sheets as often or at as high a temperature as is commonly called for. “We’ve talked about how often we change the bed-linen. It has been exciting to notice [the differences]. And the consumption, like how much [energy] it consumes” (CLL, FI Participant 14). Some participants also confessed in front of the group that they wore “home clothes” more often and that these items were much dirtier during the challenge than before. For one participant it was a revelation: “It just really snapped in my head that you can use the garment several times. Like you just take a [previously] worn piece of clothing from the hanger again” (CLL, FI Participant 14). Discussing social norms with one another rendered the norms visible, allowed criticism of them in ways that individual interviews did not, and thus supported social learning. The CLL setting might have helped the participants to have an open conversation in which norms and conventions were challenged and social learning took place. In some cases, these discussions continued when the CLL participants met each other on the street or in the apartment building.

The CLLs offered participants an opportunity to hear others talk about their perceptions of norms, particularly regarding laundry. Regarding temperature selection for laundry, for example, households did not follow the same norms, even though they believed them to be widely held and these circumstances offered an opportunity for social learning. In fact, some householders seemed genuinely surprised to hear that what they had previously perceived as normal was not a universally shared routine. “But for example forty degrees, I never wash at forty. I don’t know what to wash at forty... But does it make sense to wash the sixty-degree wash at forty? So bedding and things like that, should you also wash at forty... and towels? Because I’m currently washing them at sixty” (CLL, GER Participant 300).

Exchanges about social norms and whether participants believed they complied with them, especially in relation to cleanliness, were sometimes marked by the expression of shame in relation to one’s own practices, or disgust regarding the habits

of others, as illustrated by the following exchange between CLL participants: “A pair of jeans, I’m a bit disgusting with it, but for me it’s... one month” reported one participant (CLL, CH Participant 11), to which another answered: “What a whole month? Oh I’m disgusted, it’s disgusting, for me jeans it’s four days maximum, otherwise it’s disgusting!” (CLL, CH Participant 13). This dynamic of shame and blame shows that, during discussions between participants, social norms were discussed and challenged but also enforced. As such, the extent to which each participant reflected on the validity of their own perceptions of what is “normal” was not entirely clear. However, what is evident is that CLL participants’ norms were directly challenged during the focus group sessions and that CLL participants had the opportunity to learn from each other when sharing their views of what was normal. In the ILLs, challenges to norms were less pronounced and limited to visual and verbal information that encouraged critical self-reflection and exchanges with family members or others, including friends, neighbors, or acquaintances, who did not undergo the same experience. Similarly, there were fewer opportunities for social learning.

This said, there is also evidence of norms being challenged in the ILLs, for example through within-household interaction. “The boys use [the thermometer] as a teasing tool for me, and that’s par for the course here... I suppose they used it as a weapon really because they were saying it’s too hot, stop it, turn off the heating... they would have complained anyway but they had actual evidence now!” (ILL, IE Participant 15). Influential internal processes were observed especially in larger households whose engagement in the living labs forced them to initiate more complex processes of negotiation, communication, and cooperation than was the case for smaller households. On one hand, some families involved children in the challenges in a playful way and connected heating and laundry practices to pro-environmental goals such as reducing plastic or lowering water use). On the other hand, the events in the CLL offered some participants a welcome possibility to reflect upon their changes in practices as the other household members did not support the challenge.

To sum up, both types of living labs encouraged participants to reflect on social norms and their own standards regarding comfort and cleanliness. However, it was possible to detect differences in how these critical reflections took place. CLL participants tended to compare themselves to others while ILL participants spoke more about their own practices and preferences vis-à-vis those of other household members. Furthermore, social norms in

relation to laundry received more attention than those relating to space heating.

Discussion

Our research contributes to an understanding of the role that membership of a group or “change community” can play in practice-based living labs, throwing up interesting questions concerning the implications of our findings for the design of future change initiatives. The role of social interaction in creating commitment and peer-to-peer support deserves particular attention, in addition to the performance of the living labs in terms of changing practices and facilitating social learning.

Designing the community engagement

Our results highlight the key role of social interaction, social learning, and peer-to-peer support in change initiatives. While changes in practices were demonstrated across both the CLLs and ILLs, being part of a community initiative resulted in greater levels of reported support for alternative ways of performing heating and laundry practices. Our results illustrate the positive role of creating a community to support practice change, thereby confirming arguments by Aiken et al. (2017), that communities have “something enabling” in them. The results also show that it is important to carefully plan the recruitment of the participants and the design of the project to create opportunities for social interaction.

Nevertheless, establishing a living lab that fosters a sense of community can be challenging. In several participating countries, our team members managed to recruit about one-fifth fewer participants for the CLLs than for the ILLs. Moreover, the level and quality of community engagement depended on the type of community being created, prior connections, shared understandings of the focus of the activity, aims, motivations, cultural background, shared language, and the methodology applied by the researchers. In this study, taking part in the CLL was also more demanding for participants than was the case in the ILL, as CLL participants had to be available for focus-group meetings and to interact online during the challenges. In contrast, household visits in ILLs were arranged individually according to participants’ needs and wishes.

Reflecting critically on our experiences in designing and implementing such living labs, we suggest that future comparative living labs need to collect data in ways that enable a more rigorous comparison between the two approaches (Hossain, Leminen, and Westerlund 2019). If possible, specific data on

social interaction should be collected in order to improve the comparability of the results. Ideally, the design should also include the collection of detailed contextual information – such as membership in other communities and extent of exchange with others outside the living labs – to account for factors not directly related to the living labs (e.g., Heiskanen et al. 2019; Middlemiss 2011). It is also important to acknowledge that living lab participants regularly belong to a myriad of different place-based and interest-based communities which may or may not shape their (lack of) engagement in a practice-centered change initiative.

One major limitation of our study relates to the difficulties in determining the influence of different background communities on the performance of living lab participants vis-à-vis other influencing factors such as socioeconomic background or prior knowledge. Correspondingly, there are differences between individual households and across countries which complicate the comparison. Nevertheless, our findings show that differences relating to outcomes as a result of participation in a CLL or ILL warrant a closer examination.

In addition, our results remain ambiguous regarding the merits and pitfalls of creating a community “from scratch,” without prior ties between members. There is some indication that change initiatives might benefit from tapping into existing communities (as opposed to “designing” them). It is nevertheless important to recognize that individual communities need to be approached and addressed differently when trying to engage people in challenging and changing their everyday practices. Based on our experiences in the project, creating a specific setting for practice change (i.e., time and space for deliberation, experimentation, and reflection) is critical for the success in any type of change initiative (Sahakian et al. 2021). However, creating “communities within communities,” as was the case with the CLLs, can further support the diffusion of more sustainable practices as it may enable broader social learning (e.g., Reed et al. 2010). A limitation of our study is that we have not had the opportunity to examine whether the new practices have diffused further beyond the CLL context.

Interaction, peer-to-peer support, and commitment

Interactions in the CLLs contributed toward participants experiencing support from others, at least to some degree. This feature, in turn, helped some of them to engage more fully in the challenges. This is not to say that the participants in the ILLs were not committed to the challenge, but rather that their

resolve was influenced by factors other than being part of a group of people embarking on a sustainability transformation in relation to their heating and laundry practices. For all participants, commitment was likely born out of the social interaction with the researchers, as well as the knowledge of being part of a broader, European initiative. Yet, the more immediate and continuous social interaction with other participants as the key design difference between the two living lab initiatives seems to have contributed to variations in the reconfiguration of heating and laundry practices.

Clearly, social interaction was not limited to CLLs. As we also engaged multi-person households, in many cases there was exchange between household members influencing how they experienced the challenges. Similarly, social interaction took place with a number of other people as participants discussed the challenges with non-participants. Moreover, due to the communications about the research project, it is likely that both the participants of ILLs and CLLs felt a sense of togetherness with the other 308 households involved in the living labs. The purposefully designed CLLs nevertheless seemed to be more effective in influencing practices, as the participants were in a better position to question old practices when interacting with others. In CLLs, we were able to make the tacit knowledge of participants visible and open for contestation which seems to have contributed to stronger social learning effects than ILL participation.

Although the participants in the ILLs also met the members of the research team several times during the project, and they highlighted the importance of the research team coming to interview them in their homes, some ILL participants expressed a desire for more community support, which confirms previous findings in the literature (e.g., Heiskanen et al. 2010). In general, interpersonal interaction, whether with a research team, within the family, or with other households, appears to have played a role in making sense of the challenge and making the whole endeavor worth doing.

Differences in performance and social learning in an individual and community approach

Several authors have suggested that a community setting offers benefits in terms of challenging social norms and changing practices (e.g., Burchell, Rettie, and Roberts 2016; Heiskanen et al. 2010; Jack 2013). However, there is limited research explicitly comparing individual-change initiatives with alternatives designed to engage participants as a community. Even though it can be questioned whether the differences in participating in a CLL or an ILL are

substantial enough to draw any conclusions, our study serves to pinpoint where such differences can be found. Across quantitative and qualitative outcomes, our findings, however, systematically point in the direction that the outcomes in terms of practice change and participant evaluations of the CLL have been somewhat more positive. While we acknowledge that the necessary changes in the unsustainable consumption patterns and household practices are large at the societal level, even small changes in practices can have an appreciable impact, if they manage to diffuse and persist. Thus, our findings confirm previous studies which have highlighted the benefits of community approaches in terms of peer support and enablement and empowerment of participants (Heiskanen et al. 2010; Middlemiss 2011). The influence of social influence has been shown in particular in studies about recycling behavior (e.g., Abrahamse and Steg 2013; Dupré and Meineri 2016).

Our comparative and in-depth approach allows us to contribute further insights on how communities support social learning (Reed et al. 2010) in the context of practice change. We were able to show that many CLL participants gained new insights into everyday routines by interacting with other group members, for example by questioning how often clothes and other home textiles should be washed. A clear difference between the ILLs and the CLLs was that in the CLLs participants had the opportunity to hear people challenge or reinterpret seemingly immutable social norms (Opp 2001). The CLLs offered a safe space to question taken-for-granted social norms, such as laundering frequency. Even though participants in the ILLs also managed to change their heating and laundry practices, our group discussions showed the benefits of social learning and interactions. While all participants could monitor their electricity consumption, collective sense-making in the group allowed CLL participants to gain a better understanding of the connections between particular ways of performing practices and the related impacts on energy consumption. The support from others also justified extending the washing intervals (for example by airing the garment) and calling into question the need to wash items if they looked and smelled clean. Participants in CLLs thus learned other ways of taking care of clothes from each other. The community enabled the articulation and questioning of social norms related to comfort, cleanliness, and convenience (Shove 2003).

Nevertheless, it is important to acknowledge that all participants, in both ILLs and CLLs, changed their practices and in the end, many factors can lead to change. While our results highlight that learning

from peers was considered valuable and it enabled a better understanding of the variety of performances of practice, opening up room for deliberation and reflexivity on one's own ways of doing heating and laundry, it is not our aim to state that the living lab community was the only, or even the most important, part of the living lab design. While our findings highlight the positive experience of community engagement, our research also shows that the success of challenges and more generally of living labs can be influenced by many other motivations than community, which makes analyzing the effects of individual variables difficult. Whether the household participated in a CLL or an ILL did not matter to all of the results of the experiment (e.g., reducing the indoor temperature in the living room). Some practices seem to be less receptive to externally induced ruptures. For example, living room temperatures are likely to be influenced by the expectations of comfort of the whole family, while bedroom temperatures are limited to adults in the family making it easier to lower the temperature in the bedroom (assuming that children sleep in separate rooms). Laundry cycles, in turn, are strongly influenced by, among other things, the age, hobbies, and occupations of family members. Future research of practice-change initiatives could thus focus on the influence of the community aspect in relation to other factors.

Conclusions

Escalating expectations of comfort, cleanliness, and convenience are driving up global demand for key resources such as energy, water, and land. Feasible ways to challenge such developments thus need to be found, drawing attention to the role of everyday practices and their resource implications. In this article, we have described changes in two everyday -energy practices, heating and laundry, in two different living lab settings in seven European countries. Interviews and group discussions among households complement an analysis of the survey data. Our research shows that a community element in a living lab can make a difference to the nature of engagement of participants in challenging energy-related practices compared to an individual-change initiative. Our research highlights the importance of sharing experiences, challenging established norms together, and developing skills and commitment toward change, which can provide contribution for future research on living labs, their design, and implementation.

We could demonstrate that the community engagement supported social learning as CLL participants more thoroughly embraced alternative ways of adopting elements of practices compared with

ILL participants. Adoption of many new practices was more actively shared among the participants of CLLs (thus going beyond the individual) and learning took place thanks to the interaction within the CLLs. While the results in terms of energy savings may not have differed significantly between individual and community engagement, for the participants in the change initiatives the experience was likely different. Such initiatives can potentially enhance acceptability and longevity as well as the diffusion of less energy-intensive practices among the community, or communities, hence advancing sustainability transitions more broadly.

It is important to provide some self-reflection on our role as researchers in the process. It is critical to be open to assessing the specifics of this interaction in the change process as we had quite an active role in the living labs. We provided practical tips for practice change and materials to make the challenges more participatory and fun. The materials also offered research-based information on the necessity of sustainable energy use for participant motivation. Indeed, many participants in the ILLs also told how it was important for them to be part of a larger, European-wide research community, despite being unable to meet each other. The research team was thus an important intermediary between participants. This project could act as a springboard for future in-depth investigation on the role of various communities and contexts for practice change and whether the social dynamics in these different contexts cause conflicts in change efforts. Still other avenues for further research could focus on the long-term effects of interventions addressing household practices by examining whether such change initiatives leave permanent adjustments in households and whether the spread of new practices in the community can be supported to advance an overall energy transition.

Notes

1. The ENERGISE project has catalogued a wide range of community-led sustainable energy projects. See the online database at <http://energise-project.eu/projects>.
2. See <http://www.openlivinglabs.eu/aboutus>.
3. Although eight countries participated in the intervention, in the United Kingdom (UK) only five households in the CLL responded to the questionnaires, so the UK had to be omitted from the quantitative analysis due to the small number of observations. Seven countries remained, namely Denmark, Finland, Germany, Hungary, Ireland, the Netherlands, and Switzerland.

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Appendix A

Table A1. Background information of the participating households

	CLL		ILL	
	<i>n</i>	%	<i>n</i>	%
Dwelling				
Detached house	42	33.1	79	57.2
Semi-detached or terraced house	36	28.3	34	24.6
Apartment	46	36.2	23	16.7
Other	3	2.4	2	1.4
Total	127	100	138	100
Family size				
1–2 persons	54	42.5	61	44.5
3–4 persons	61	48.0	51	37.2
5 or more	12	9.4	25	18.2
Total	127	100	137*	100
Age of contact person				
25–34	12	9.5	16	11.68
35–44	36	28.6	33	24.1
45–54	42	33.3	37	27.0
55–64	15	11.9	34	24.8
65+	21	16.7	17	12.4
Total	126*	100	137*	100

* The totals for the three household characteristics are different for each of the two types of living lab due to missing survey responses.

Appendix B

The results of reaching the challenges

The variables for room temperature were the differences between the average temperatures in the living room and in the bedroom between the baseline period and the challenge period. The explanatory variable for laundry was the relative change in weekly laundry cycles between the follow-up period and the challenge period.

The analysis shows that the indoor temperatures declined by about one degree (Celsius) for all countries in all living labs: the temperature in the bedroom for CLLs decreased from 20.4°C to 18.7°C and for ILLs from 19.6°C to 18.4°C. Throughout the initiative, room temperatures for ILLs were on average lower during both the follow-up and challenge periods. This may be explained by the higher proportion of single-person households in the ILLs. In single-family homes,

heating usually accounts for a larger share of total energy consumption, which in principle leads the individual households to try to save more on energy. In the laundry challenge, the households in CLLs reduced their weekly laundry cycles from 4.4 to 3.0 loads and in ILLs from 4.3 to 3.1 loads.

In order to analyze, whether there was a difference between the CLLs and ILLs in how much the households had reduced their room temperatures and their laundry cycles during the challenge, we used the independent sample *t*-test. According to the two-way *t*-test, the reduction in the room temperatures in the bedroom of the CLLs is significantly different from the ILLs' reduction in the bedroom temperature. The difference between the reduction in living room temperature and the reduction in laundry cycles did not prove to be statistically significant. The results are summarized in Table B1.

Table B1. Summary of independent samples *t*-test results for reduction in temperature and in laundry.

Variable	CLL	ILL	t	p
Temperature difference in the living room				
Mean	1.10	0.94	−1.047	.296
SD	1.26	1.15		
n	114	128		
Temperature difference in the bedroom				
Mean	1.59	1.27	−1.988	.048
SD	1.31	1.20		
n	113	128		
Change in the number of laundry cycles %				
Mean	29.79	23.24	−1.340	.182
SD	29.07	44.60		
n		104		126